



**Federal Aviation
Administration**

Best Equipped-Best Served (BEBS)

Presented to: Public Consultation

Presented by: Richard Jehlen
Director, Operational Concepts,
Validation & Requirements,
Mission Support Services, ATO

Date: March 13, 2012



Background

- **Both the NextGen Advisory Committee (NAC) and RTCA Task Force 5 provided input endorsing services for better equipped aircraft.**
- **The NextGen Management Board tasked a workgroup to identify a selection of operational candidates that respond to the inputs and can be implemented in the near term (approximately 24 months).**
- **The focus of the activity was on initiatives supporting operational incentives to encourage equipage.**
 - There are many ongoing activities (OAPM, PBN, etc) working to capture early user benefits. BEBS is a distinct, separate activity.
- **Workgroup participation came from across the Agency's Lines of Business (ATO, AVS, ANG, APL, ARP, NATCA, AGC, Mitre /CAASD, etc..)**
- **Potential pool reduced to “Top 10” candidates by workgroup through assessment of implementation timescale, operational viability, risk, etc.**
- **They are organized into 5 technological/use areas.**



Candidate Scenarios

BEBS 1: De-Conflict Airport Operations/Lower Weather Minimums

1A. JFK

1B. LGA

1C. TEB

1D. MDW

BEBS 2: SOIA (Paired SOIA Paired Aircraft Approaches):

2A. PHL

2B. SFO

2C. EWR

BEBS 3: ADS-B East Coast offshore routes

BEBS 4: ADS-B In Trail Procedures (ITP) / South Pacific and Beyond

BEBS 5: NextGen Minimum Capability Priority

Contextual Elements Supporting Today's Discussions

- “Most Capable” varies by specific site, Metro area, WX conditions, time of day, fleet mix, etc.
 - Under some of the scenarios the conditions for application present themselves between 5% and 15% of the time
- The scenarios reflect a risk mitigated evolution of NAS, while improving operations and capturing benefits in some of the most constrained airspaces.
 - One objective is to avoid unintended consequences.
- These are candidates for consideration to begin moving forward together.
 - Significant efforts remain for the candidate(s) selected for implementation.
 - Based on the specific, details of implementation challenges ranging from environmental, regulatory, or operational may still present themselves.
- Both operators and the FAA share operational dependencies requiring redress for successful large-scale transition enabling NAS to maximize the use of advanced avionics capabilities.



Operational Dependencies

- Best equipped does not provide sufficient information to determine “true” operational capability:
 - While the airframe may be equipped, use of a specific procedure is dependent on crew training, certification and willingness to execute the maneuver
 - “Training of controllers, aircrew, and dispatchers, plus equipage are integral components of a “Best-equipped, Best-served” NAS.” [RTCA TF5, page 68]
- There are significant operational impacts for mixing aircraft not capable of executing the specific procedure/maneuver. (This includes unknown to the ATM system until the last moment.)
 - There is currently no automated means to gain access to the information regarding “capable” vice “not capable”
- Responding to these dependencies will require joint, coordinated efforts by operators and the FAA.

BEBS 1

Scenario Candidate: PBN Approaches to De-conflict Airports/Lower Weather Minimums

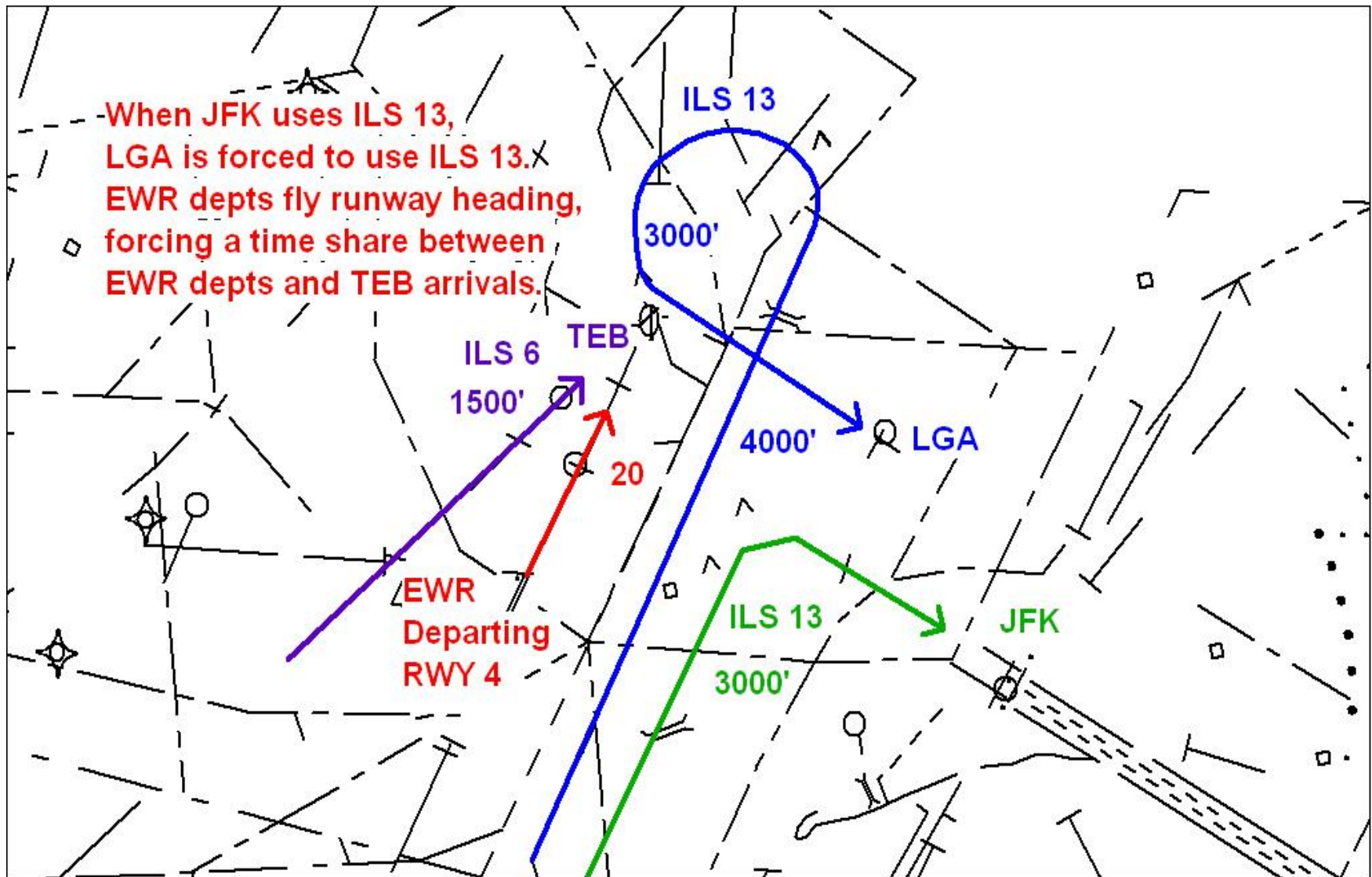
BEBS 1A JFK PBN Approaches to RWY's 13L

BEBS 1B LGA PBN Approaches to RWY's 13/31

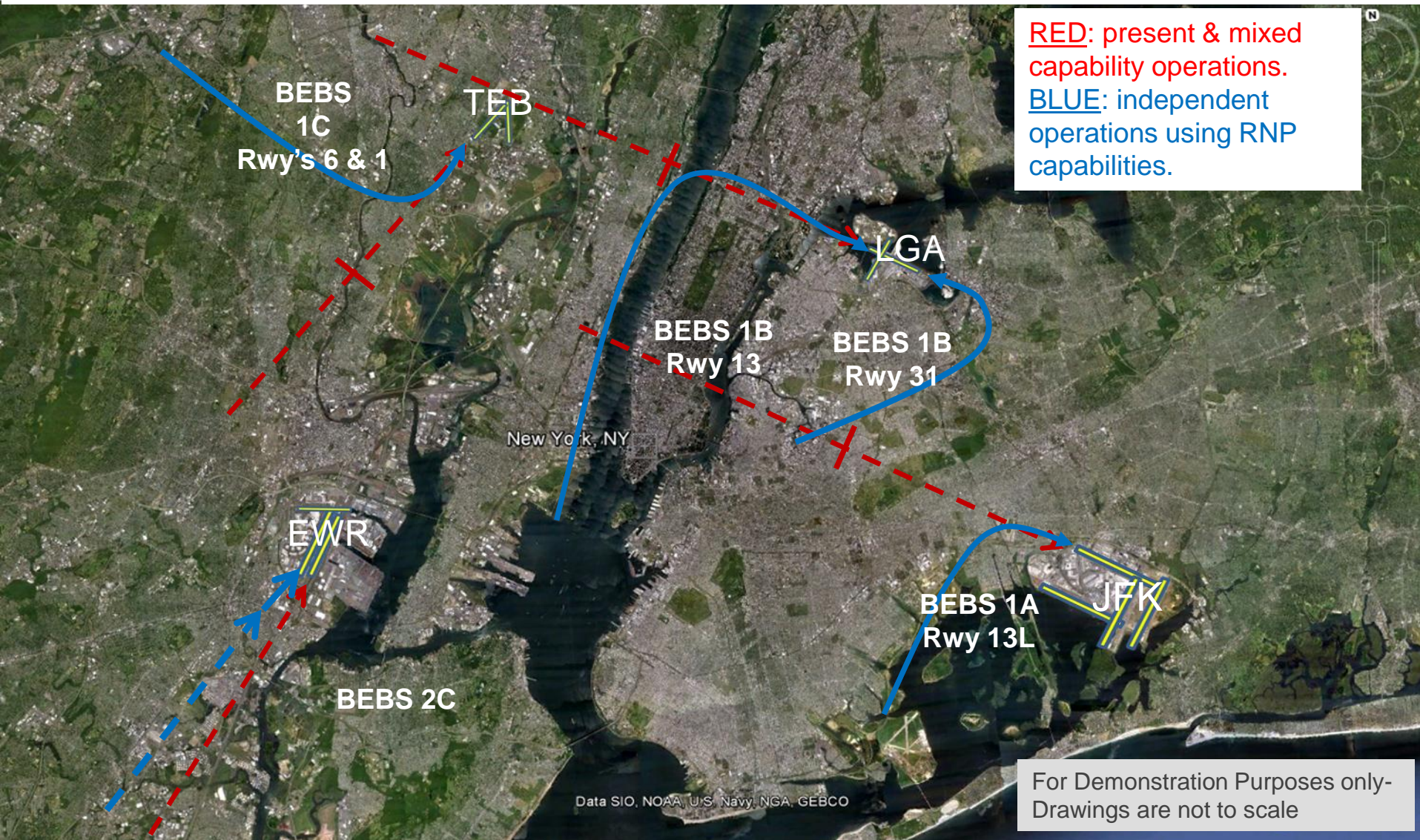
BEBS 1C TEB PBN Approaches to RWY's 6/1

BEBS 1D MDW PBN Approaches to RWY 13C

NY Airports – Interdependency Example



BEBS 1: PBN Approaches to De-conflict NY Metro Airports



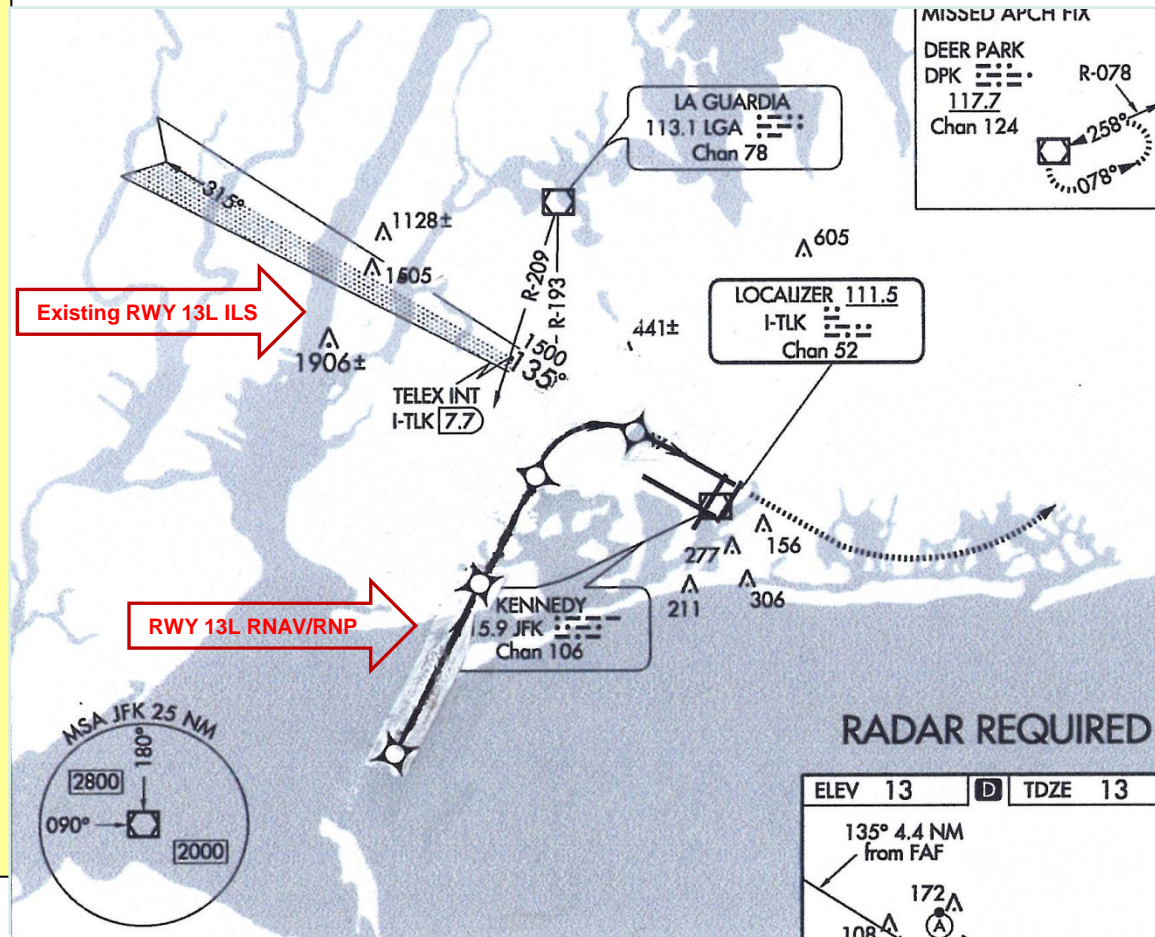
BEBS 1A: PBN Approaches to JFK RWY 13L

Description: Tracking existing Charted Visual Flight Procedure (CVFP) to incorporate RNAV/RNP w/ RF legs for JFK RWY 13L

This operation allows increased landing opportunity by remaining in Visual rates during lower weather and/or specific wind conditions. De-conflicts operation between LGA and JFK

This approach would not force LGA onto the ILS RWY 13 approach which impacts EWR and TEB. Landing on RWY13L are frequent and favored operations at JFK using the Charted Visuals Approach Procedures.

This procedure substantially lessens the requirements for ILS RWY 13L which conflicts with LGA and EWR operations.



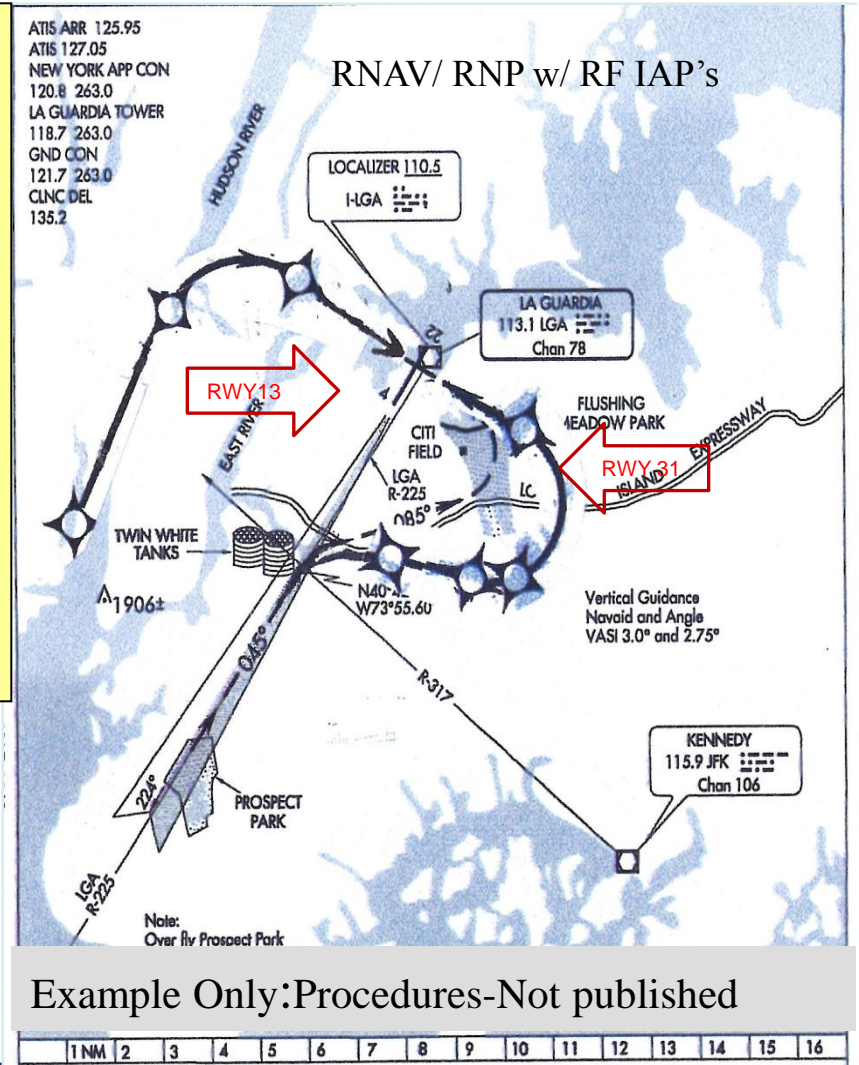
Example Only: Procedures-Not published

BEBS 1B: PBN Approaches to LGA RWY 13/31

Description: Tracking existing Charted Visual Flight Procedure (CVFP) to incorporate RNAV/ RNP w/ RF legs for LGA RWY 13 & 31.

This operation allows increased landing opportunity by remaining in Visual rates during lower weather and/or specific wind conditions. Landing on RWY 31 is a frequent and favored operation at LGA using the Expressway Visual.

Reduced minimums will substantially lessen the requirements for ILS RWY 4 w/ circling operations, which are very inefficient. De-conflicts with JFK operations to RWY 22R.



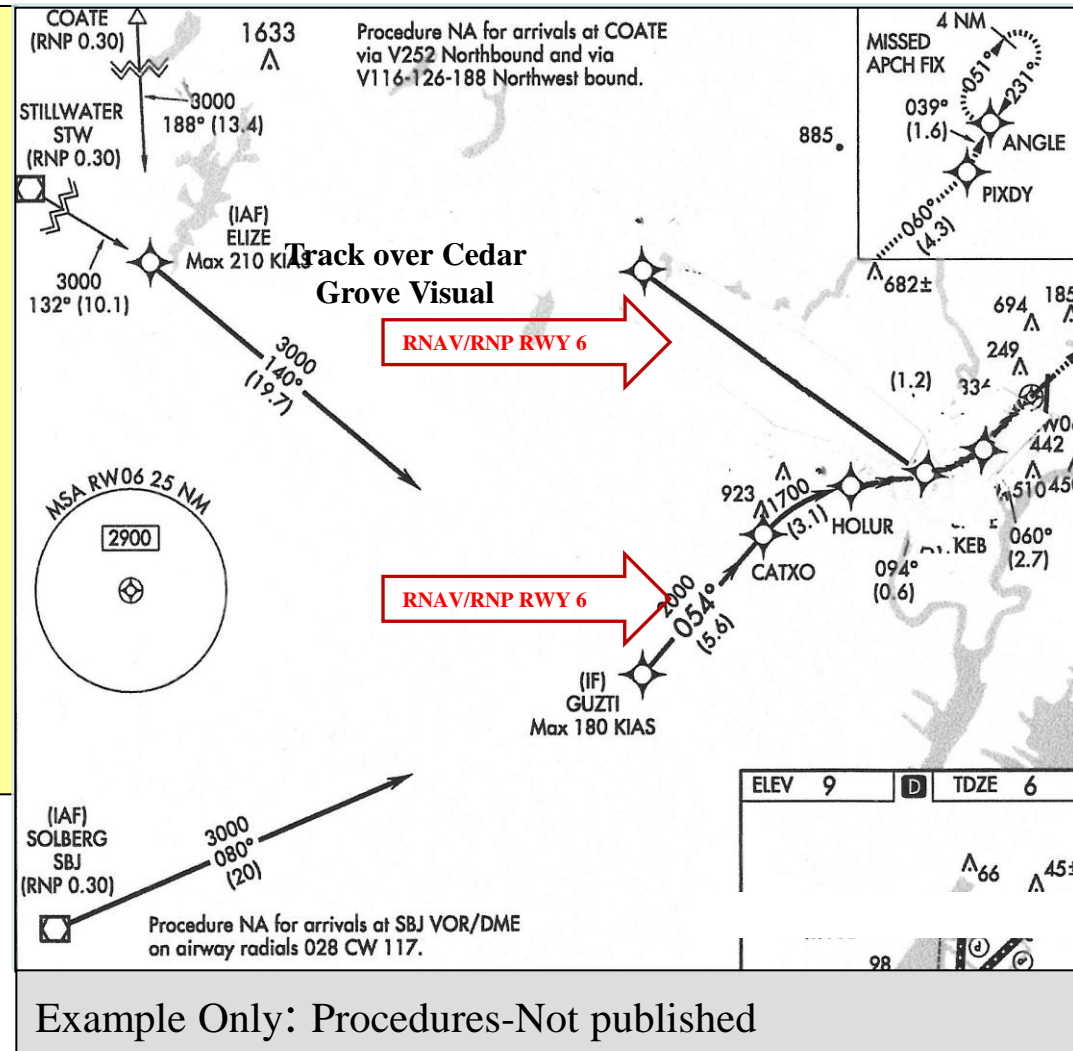
BEBS 1C: PBN Approaches to TEB RWY's 6/1

Description: Tracking existing Charted Visual Flight Procedure (CVFP) to incorporate RNAV/ RNP w/ RF legs for TEB RWY 6 and RWY 1.

This operation allows increased landing opportunity by remaining in Visual rates during lower weather and/or specific wind conditions. De-conflicts operation between TEB and EWR.

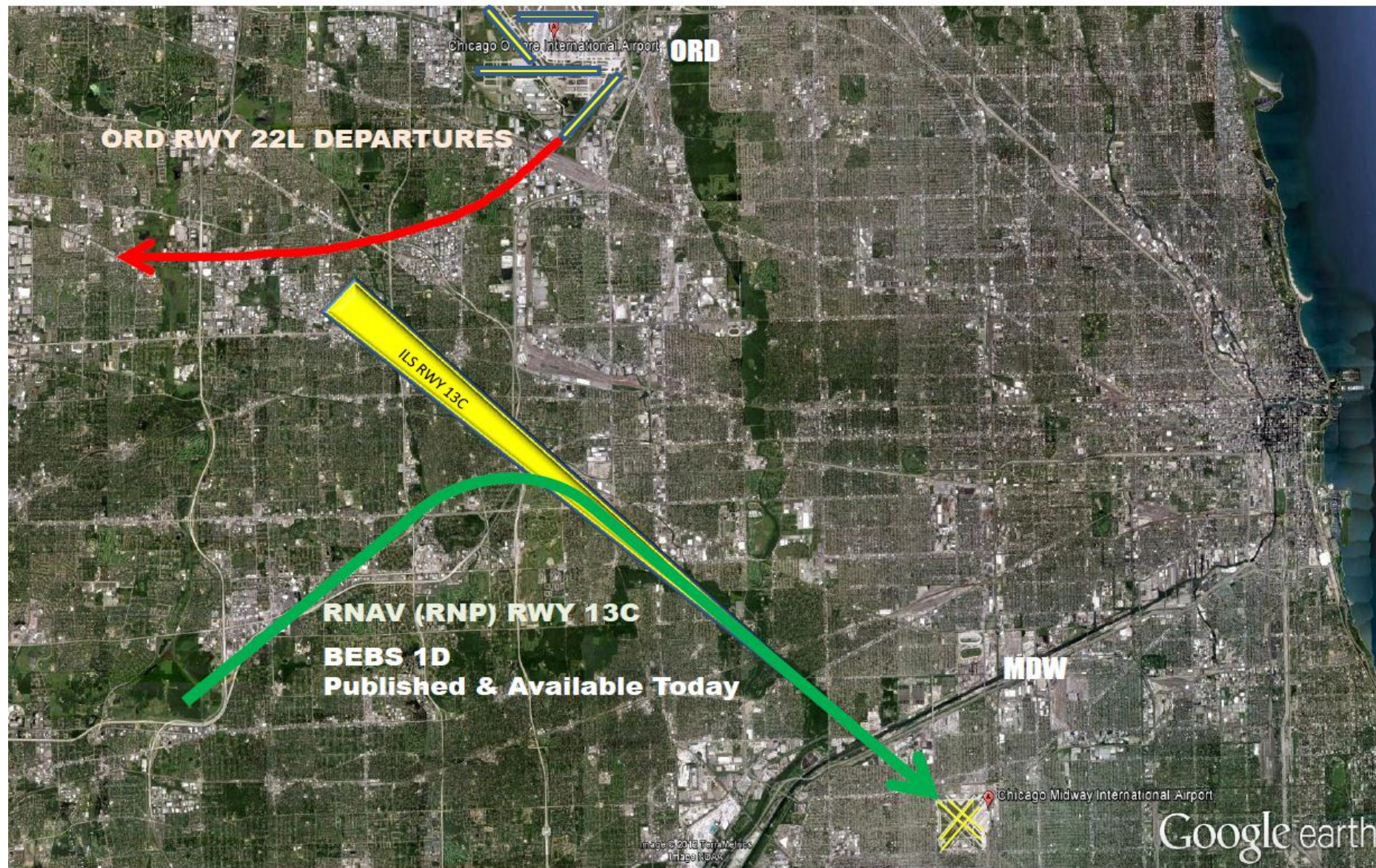
Landing on RWY 6 and RWY 1 are frequent and favored operations at TEB using the Passaic River and Cedar Grove Visuals.

This procedure substantially lessens the requirements for ILS RWY 6, which conflicts with EWR operations to RWY 22L/R and RWY 4L/R.



Example Only: Procedures-Not published

BEBS 1D MDW PBN Approach to RWY 13C

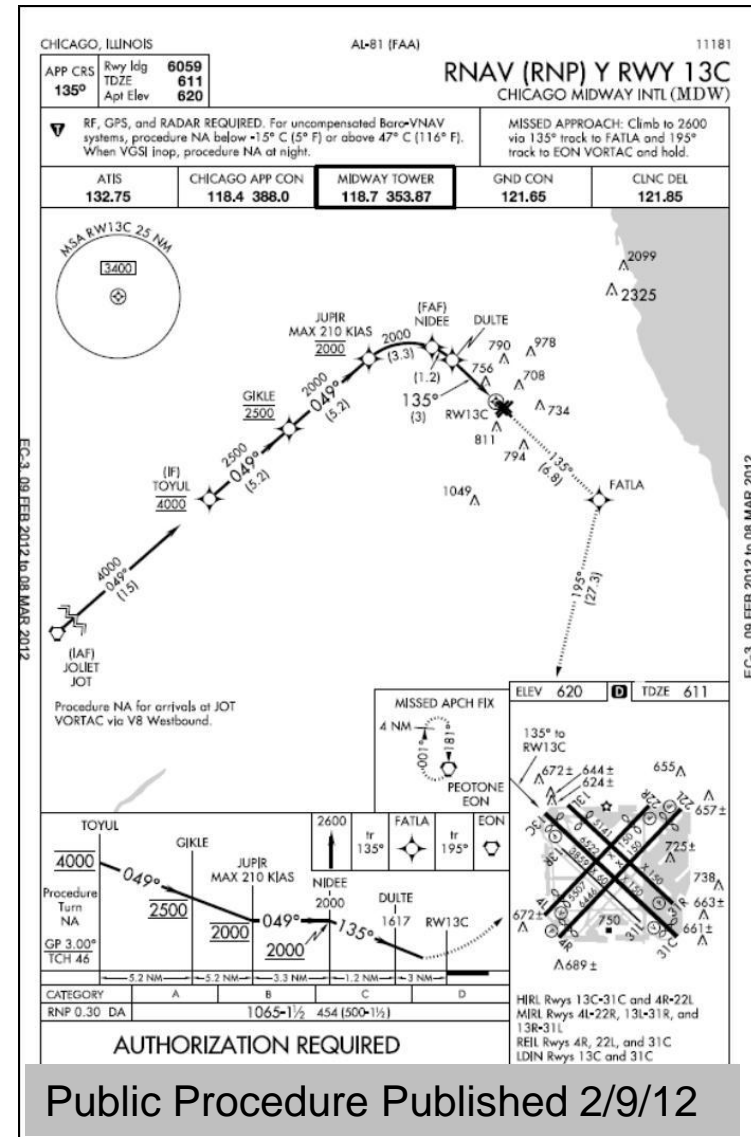


BEBS 1D: MDW PBN Approach to RWY 13C

Description: This operation de-conflicts the arrival flows at MDW from ORD operations using custom RNAV STARS with a transition to RNP w/ RF legs to MDW RWY 13C. Whenever MDW is using RWY 13C for arrivals and ORD traffic is departing on Runway 14R and arriving on Runway 22L, a potential traffic conflict exists. The missed approach path for MDW Runway 13C conflicts with the missed approach path for ORD Runway 14R. The MDW Runway 13C ILS approach path also interferes with the departure path for ORD Runway 22L. These operational constraints force delays into MDW's and ORD's respective arrivals and departures and can create bottlenecks during periods of peak traffic.

Typically, Runway 13C is only used for arrivals in certain weather conditions. Under these conditions, ORD RWY 22L departures have to be relocated to another runway for takeoff, which results in a reduced arrival rate because these departures that would normally utilize runway 22L must taxi to one of the arrival runways, thus taking an arrival slot.

This places O'Hare in a ground delay program, reducing its arrivals rate to 68 per hour from the normal rate of 92-112 arrivals per hour.



BEBS 1

Qualitative Benefits:

- Maintains visual approach through-put rates
- De-conflicts operational flows to adjacent airports increasing capacity

| Location | RNP 0.3 Approach with RF Leg outside the FAF Equipped Capability (Ops Approved) |
|--------------------|---|
| NAS Wide | 43% (26%) |
| New York Metroplex | 43% |
| LGA | 34% |
| JFK | 43% |
| EWR | 53% |
| Chicago Metroplex | 30% |
| ORD | 23% |
| MDW | 56% |

** Table courtesy of Mitre/CAASD

NAC Recommendation :

2: Given the high cost of retrofitting the entire Part 121 fleet for RNP 0.3 with RF legs, FAA, in collaboration with the aviation community, should develop capabilities (including needed policies, procedures, and complementary automation) to allow the large percentage of currently equipped users to routinely perform RNP 0.3 with RF leg procedures to realize near-term benefits in a mixed equipage environment and to stimulate forward fit and retrofit decisions.

Challenges:

- Controller Decision Support tools re: Capable vs. Not Capable
- Impacts due to non-capable aircraft mix
- Foreign Air Carriers Crew Qualifications for PBN IAP's
- Noise & Environmental Concerns
- Air Traffic & Pilot Acceptance

Risks:

- Cost to User's to equip, OPSPEC approval and train crews
- Schedule re: Design and Publication of public procedures
- TFMS Dependencies re: Priority Sequencing (if automation the choice to avoid mixed capability operating environment)



BEBS 2

Scenario Candidate: PBN SOIA Paired Approaches

BEBS 2A PHL PBN SOIA Paired Approaches RWY 9/27
BEBS 2B SFO PBN SOIA Paired Approaches RWY 28
BEBS 2C EWR PBN SOIA Paired Approaches RWY 4



BEBS 2A: PHL PBN SOIA Paired Approaches

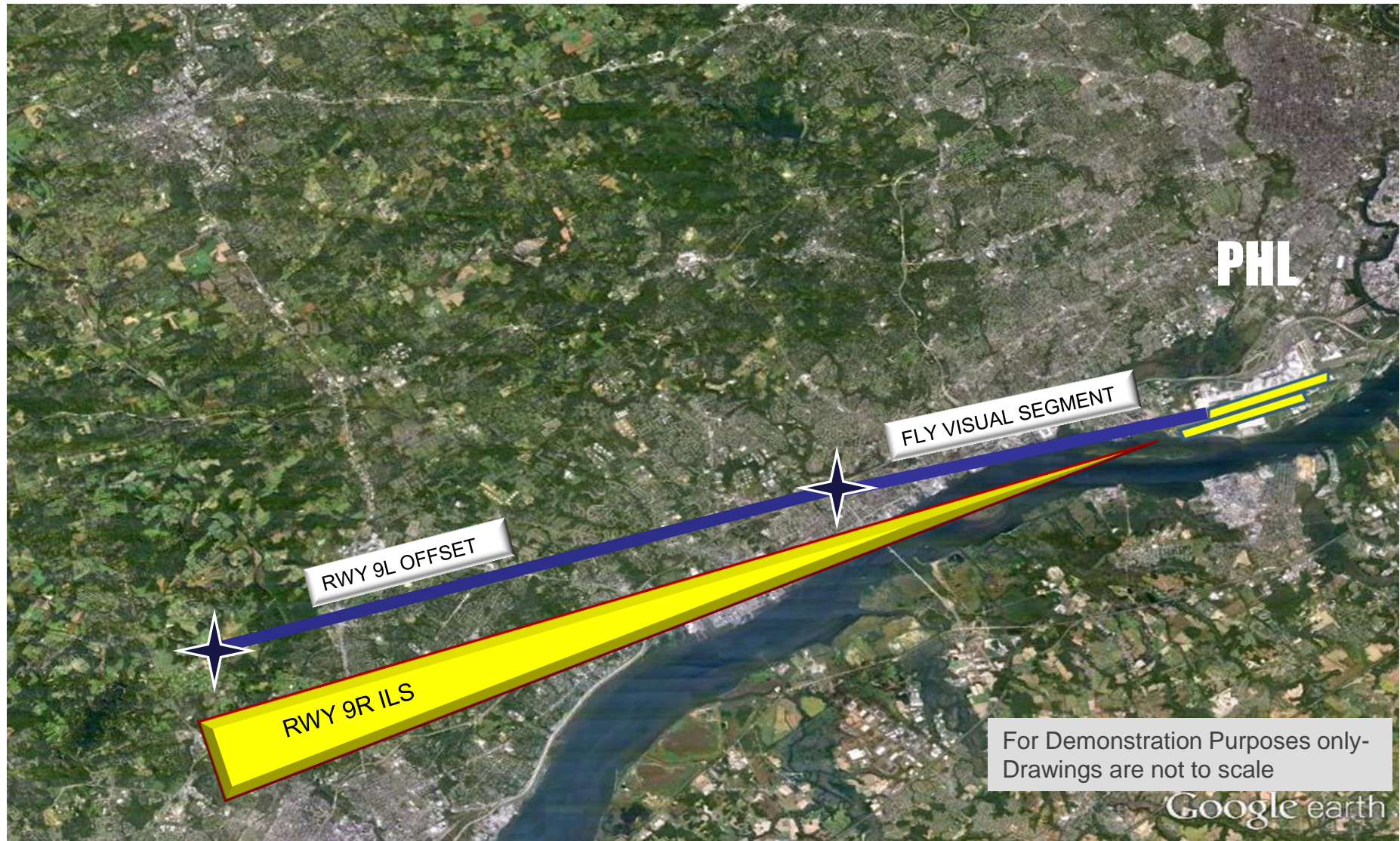
Description: This is a Simultaneous Offset Instrument Approach (SOIA) for paired aircraft approaches to parallel runways separated by 1400 ft. at PHL, with or without PRM using existing aircraft capability and an RNP capability to the offset approach runway.

Paired approach to parallel runways to continue with higher arrival rates to less than visual conditions using ILS or PBN for offset runway.

This is an approach with lower minimums than existing visual approach minimums to eventual visual separation procedures to a landing on RWYs 9L/R and 27L/R provided by ATC and/or pilot.



BEBS 2A: PHL PBN SOIA Paired Approaches



BEBS 2B: SFO SOIA Paired Aircraft Approaches

Description: This is a Simultaneous Offset Instrument Approach (SOIA) for paired aircraft approaches to parallel runways separated by 750 feet at SFO, with or without PRM using existing aircraft capability and an RNP capability to the offset approach runway.

Paired approach to parallel runways to continue with higher arrival rates to less than visual conditions using ILS or PBN for offset runway.

This is an approach with lower minimums than existing visual approach minimums to eventual visual separation procedures to a landing on RWYs 28L/R provided by ATC and/or pilot. Implementation with RNP 0.3 w/RF legs for the offset.



BEBS 2B: SFO SOIA Paired Approaches Runway 28 L & R



BEBS 2C: EWR SOIA Paired Aircraft Approaches

Description: This is a Simultaneous Offset Instrument Approach (SOIA) for paired aircraft approaches to parallel runways separated by 950 ft. at EWR, with or without PRM using existing aircraft capability and an RNP capability to the offset approach runway.

Paired approach to parallel runways to continue with higher arrival rates to less than visual conditions using ILS or PBN for offset runway.

This is an approach with lower minimums than existing visual approach minimums to eventual visual separation procedures to a landing on RWYs 4L/R provided by ATC and/or pilot. Implementation with RNP 0.3 w/RF legs for the offset.



BEBS 002C EWR SOIA Paired Approaches RWY 4 L & R



BEBS 2 Overview

Qualitative Benefits:

- Paired Approaches during less than visual approach conditions enhances capacity
- Accommodates Capable and Non-Capable flights

Equipage/ Capability:

PBN -- RNAV RNP 0.3 w/RF leg is enabled by

1. GPS with Approach Capability, or
2. RNP capable FMC with multi-scan DME/DME and GPS sensors, and
3. Advanced NAV Display capable of RF legs

PHL Traffic Sample (517) Jets only:

RNP 0.3 w/ RF:

~42% a/c are equipped (216)

~58% a/c are non-equipped (301)

SFO Traffic Sample (520) Jets only:

RNP 0.3 w/ RF legs:

~58% a/c are equipped (304)

~42% a/c are non-equipped (216)

EWR Traffic Sample (390) Jets only:

RNP 0.3 w/ RF legs:

~48% a/c are equipped (187)

~54% a/c are not-equipped (213)



NAC Recommendations:

2. Given the high cost of retrofitting the entire Part 121 fleet for RNP 0.3 with RF legs, FAA, in collaboration with the aviation community, should develop capabilities (including needed policies, procedures, and complementary automation) to allow the large percentage of currently equipped users to routinely perform RNP 0.3 with RF leg procedures to realize near-term benefits in a mixed equipage environment and to stimulate forward fit and retrofit decisions.

Challenges:

- Complementing FAA Order 7110.308
- Air Traffic & Pilot Acceptance
- ATM (Controller) Decision Support tools re: Capable vs. Not - Capable Arrival staging for departures
- Arrival staging for departures

Risks:

- Procedures Design & Publication Delays
- Noise and Environmental Concerns
- TFMS for Sequencing Traffic

BEBS 3

Scenario Candidate: ADS-B East Coast Off Shore Routes



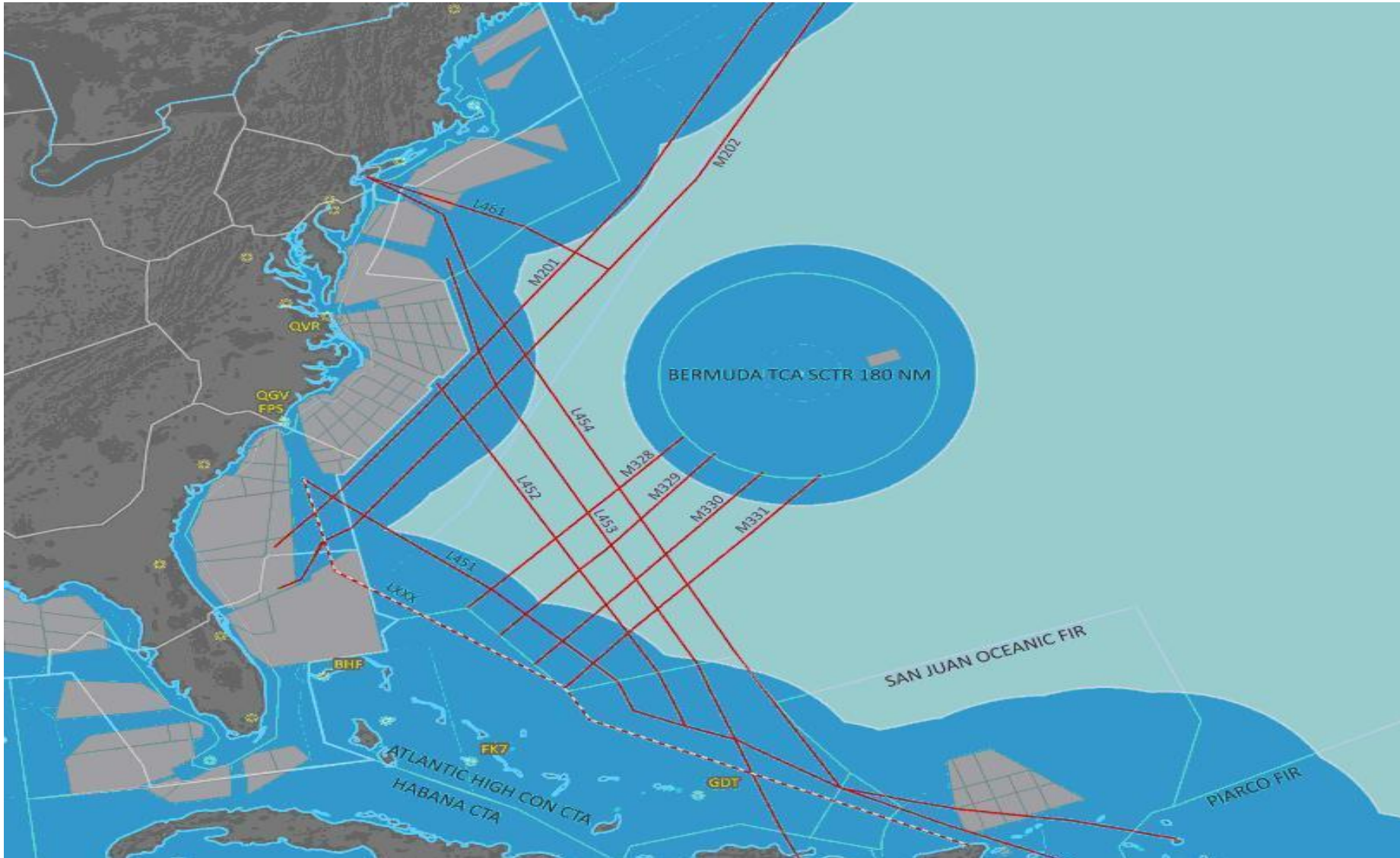
BEBS 3: ADS-B Off-Shore Routes

Description: M201 is normally closed to air traffic when Oceana and/or Fort Fisher LRR are not in service, or for severe off-shore weather. ADS-B would provide surveillance redundancy and continuity of operations along these routes for ADS-B aircraft in the event of loss of radar, or deviations for WX east of M201.

The impact of closing M201 to traffic goes well beyond any additional distance that would be required for an alternate route. The available alternate routes are all along the congested East Coast corridor.

Frequently, the reason a flight chooses M201 is to escape extremely high departure delays for flights scheduled along the East Coast mainland routes.

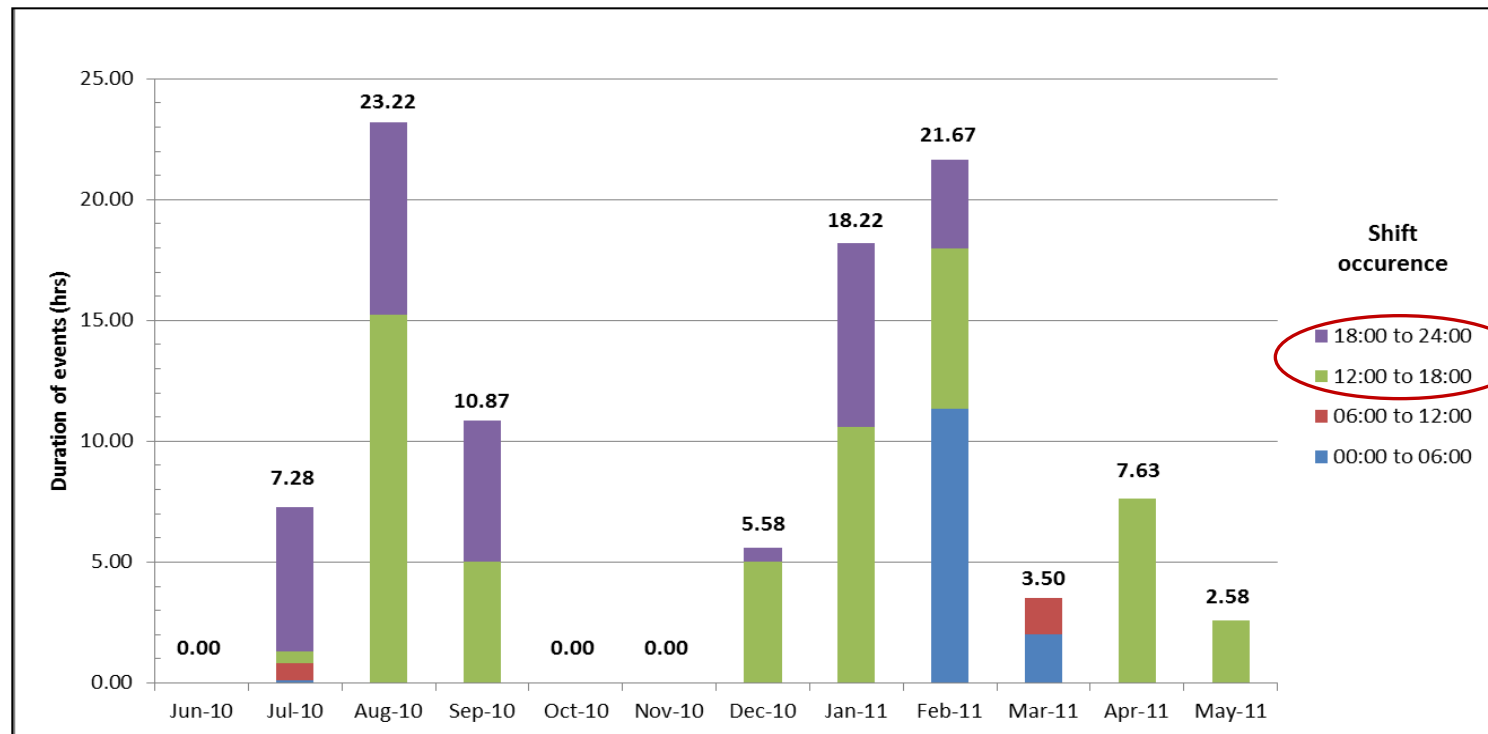
BEBS 3: ADS-B Off-Shore Routes



Initial Correlation of M201 Closure during Long Range Radars (LRR) Outages and Weather/Volume Events

- Completed analysis of baseline set for one year; 6/1/2010 – 5/31/2011

| | M201 Closed due to LRR outages | M201 Closed due to LRR outages, correlated with Wx/Volume | Correlation |
|-----------------------------------|--------------------------------|---|-------------|
| Number of Events | 69 | 21 | 30% |
| Total duration, all events (days) | 16.55 | 4.19 | 25% |



BEBS 3

Qualitative Benefits:

- Capable users could avoid extensive departure delays by choosing the ADS-B off-shore routes, where radar coverage may be insufficient or unavailable. thus easing congestion on the normal inland East Coast routes.
- Removing ADS-B capable flights from the departure queue could potentially improve efficiency for remaining aircraft

Equipage/ Capability:

ADS-B Out

Implementation Risks:

- New York Center (ZNY) needs to be operational with the En Route Automation Modernization (ERAM) system Release 3 (R3) , which will allow the display of these aircraft as ADS-B targets (IOC 2013).

ADS-B East Coast Off-shore:

- Equipage will allow aircraft to fly using radar-like separation on M201 when the Ft. Fisher and Oceana LRRs are out of service or because of weather deviation aircraft must operate outside of radar coverage east of M201.

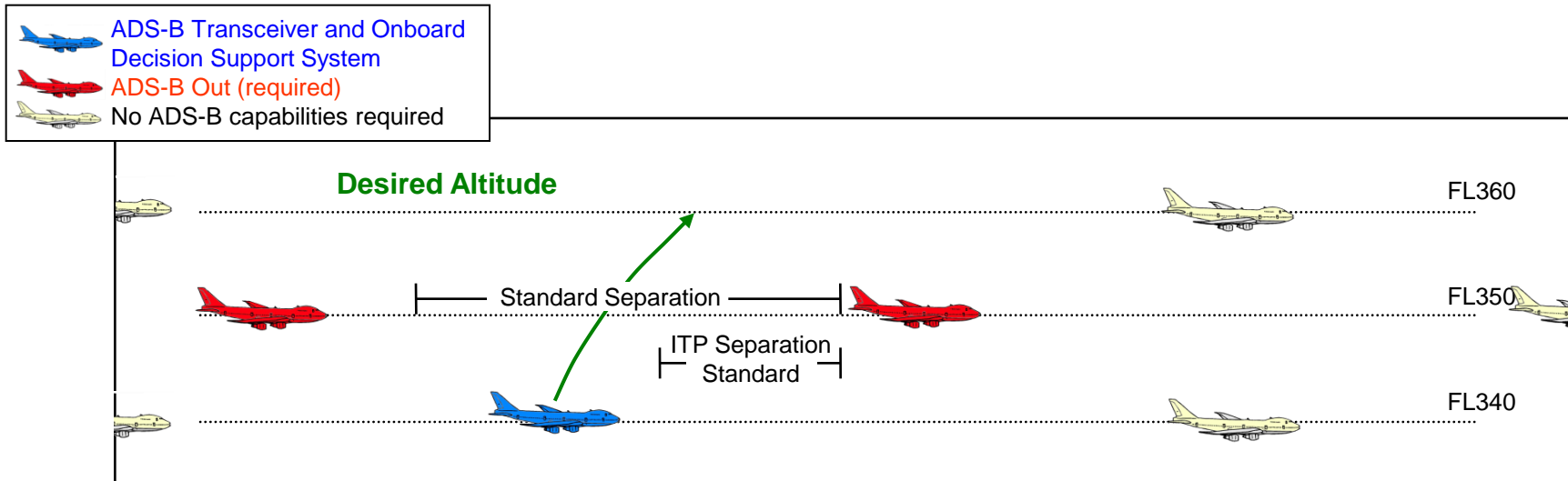


BEBS 4

Scenario Candidate: ADS-B In-Trail-Procedures (ITP)



Operational Benefit for ADS-B In-Trail Procedures



NEED



CHALLENGE

=

OPPORTUNITIES

➔ **Altitude Changes** required for better fuel economy, winds, and ride quality

➔ **The combination of locally dense traffic and large separation minima limits altitude changes**

➔ **Use airborne ADS-B applications to enable altitude changes otherwise blocked by conventional operations**

BEBS 4: ADS-B In-Trail-Procedures (ITP)

Description:

The ADS-B ITP concept is to increase the efficiency of long-haul flights while maintaining the current level of safety. The concept takes advantage of “ADS-B In” to display traffic on an Electronic Flight Bag (EFB). In addition to increasing flight crew awareness of the traffic around them, ITP displays offer the capability of climbing or descending through altitudes currently blocked by traffic due to procedural separation standards. After flight crews gain experience with the ITP display and the capability of the ITP to optimize altitude, it is expected that they will be comfortable lowering the amount of contingency fuel carried, thereby reducing fuel burn and carbon emissions.

BEBS 4

Qualitative Benefits:

Fuel and time savings achieved by attaining and maintaining optimum altitude

Equipage/ Capability:

- ADS-B In
- ITP application
- EFB

Current Demonstration Project:

Conduct operational flight evaluations of ADS-B ITP on a selection of B747-400 aircraft in revenue service on routes between the U.S. west coast and Australia, using certified avionics equipment (Aug 2011-Aug 2012).



BEBS 5

NextGen Minimum Capability Priority (NMCP)



Description: NextGen Minimum Capability Priority (NMCP)

- Aircraft meeting the NextGen defined minimum capability are provided benefit when encountering any traffic management initiative (TMI)
 - The benefit is provided whether the specific capability is directly related to the TMI or not.
- Capable aircraft are prioritized in Air Traffic Management (ATM) processes (e.g., TFMS, FSM)
- The bounds for this application of “Most Capable” are very broad. In actual operation it could be scoped to:
 - Limit applicability to specific type of TMI (GDP, AFP, metering, etc)
 - Specific time of day (peak system demand)
 - Limit any dis-benefit to specific value (no more than 5 minutes of additional delay for non-capable)
- NMCP can be applied to any specified equipage and/or operational capability or combination. The “minimum” NextGen capability level would be increased in a known fashion on a known schedule.

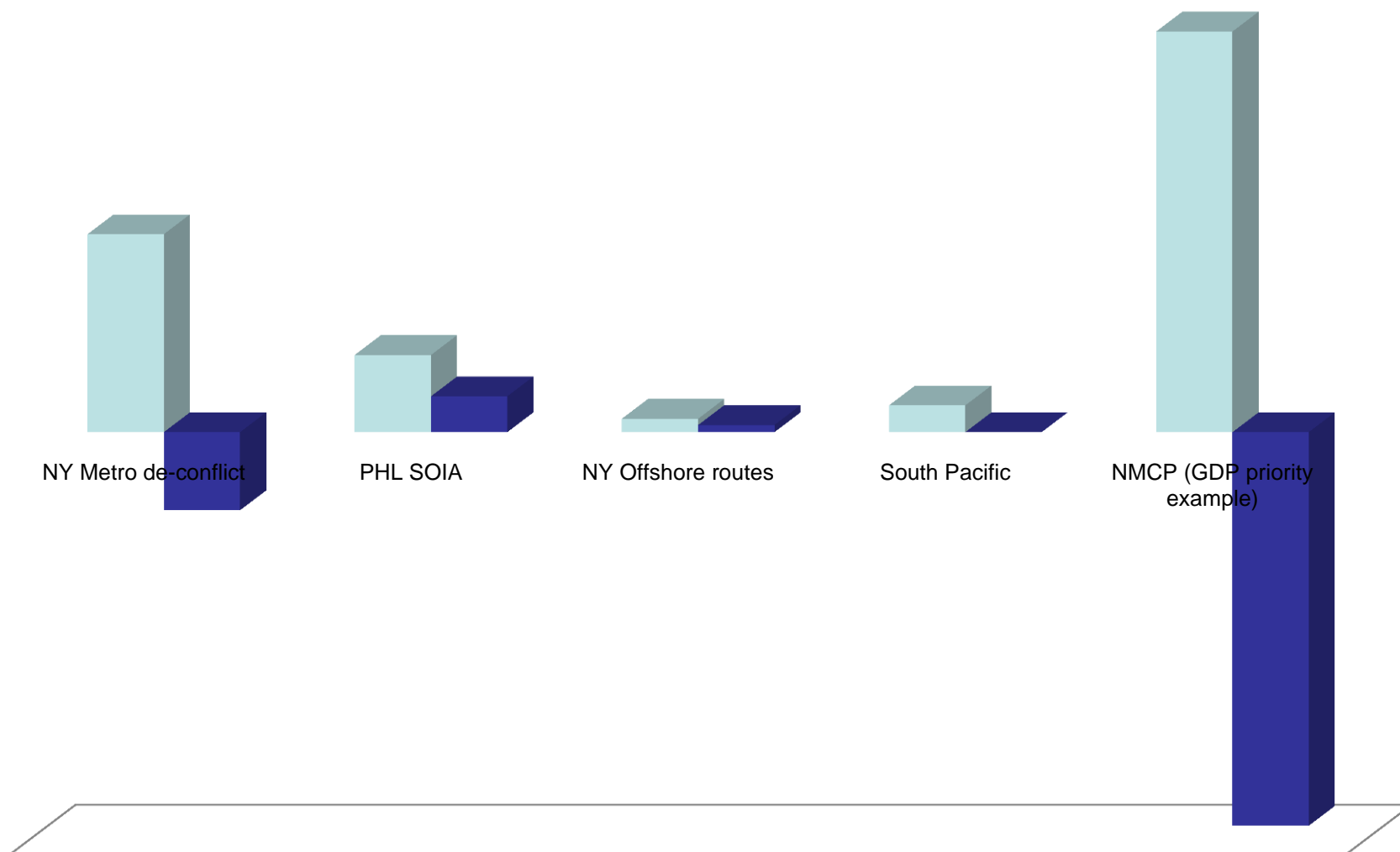
Notional NextGen Minimum Capability Targets & Timeframes

| Incentivized Equipage/Capability | Target Timeframe |
|---|------------------|
| RNP.3+RF | Present-2018 |
| RNP.3+RF and ADS-B OUT | 2018-2020 |
| RNP.3+RF and ADS-B OUT and ADS-B IN | 2020-2025 |
| RNP.3+RF and ADS-B OUT and ADS-B IN and Data Comm | 2025+ |



Relative Delay Comparison - Sample Operational Scenarios

■ delay reduction for equipped
■ impact on the unequipped



Thank You

